The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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[illegible]tration under the Companies Act does not constitute a new legal entity but merely [illegible]ny to certain additional company law rules.

Signed

Dated 24 MAY 2001

CERTIFIED COPY OF PRIORITY DOCUMENT

Patents Form 7/77

Patents Act 1977
(Rule 15)

The Patent Office

7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference: Jg-2614

2. Patent application number *(if you know it)*: **0014671.2**

15 JUN 2000

3. Full name of the or of each applicant: SEOS DISPLAYS LIMITED

4. Title of the invention: HEAD SLAVED AREA OF INTEREST (HSAOI) USING FRAMESTORE DEMULTIPLEXING

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent: BY VIRTUE OF AGREEMENT AND CONDITIONS OF EMPLOYMENT

6. How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*: 2

7. I/We believe that the person(s) named over the page *(and on any extra copies of this form)* is/are the inventor(s) of the invention which the above patent application relates to.

Signature: GRAHAM JONES & COMPANY

Date: 15/6/00

8. Name and daytime telephone number of person to contact in the United Kingdom:

GRAHAM H. JONES
EUROPEAN PATENT ATTORNEY
CHARTERED PATENT ATTORNEY
TRADE MARK ATTORNEY

020 8858 4039

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.*

d) *When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.*

e) *Once you have filled in the form you must remember to sign and date it.*

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

GEOFFREY HOWARD BLACKHAM
58 ADASTRA AVENUE,
KEYMER,
WEST SUSSEX, BN6 8DR,
UNITED KINGDOM

3620895002

Patents ADP number *(if you know it)*:

IAN MURDOCH MACPHERSON,
9 MAYFIELD COURT,
JUNCTION ROAD,
BURGESS HILL,
WEST SUSSEX, RH15 0TN,
UNITED KINGDOM.

Patents ADP number *(if you know it)*: 7191521001

Patents ADP number *(if you know it)*:

Reminder

Have you signed the form?

Patents Form 1/77

Patents Act 1977
(Rule 16)

15 JUN 2000
LONDON

The Patent Office

14NOV00 E545417-3 D01821
P01/7700 0.00-0014671.2

1777

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

Jg- 2614

2. Patent application number
(The Patent Office will fill in this part)

0014671.2

15 JUN 2000

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

SEOS DISPLAYS LIMITED,
EDWARD WAY,
BURGESS HILL,
WEST SUSSEX, RH15 9UE
UNITED KINGDOM

Patents ADP number *(if you know it)* 6917256003

If the applicant is a corporate body, give the country/state of its incorporation

UNITED KINGDOM

4. Title of the invention

HEAD SLAVED AREA OF INTEREST (HSAOI) USING FRAMESTORE DEMULTIPLEXING.

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

GRAHAM JONES & COMPANY
77 BEACONSFIELD ROAD,
BLACKHEATH,
LONDON SE3 7LG

Patents ADP number *(if you know it)* 2097001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	6
Claim(s)	
Abstract	
Drawing(s)	3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	3 /
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature GRAHAM JONES & COMPANY Date 15/6/00

12. Name and daytime telephone number of person to contact in the United Kingdom

GRAHAM H. JONES
EUROPEAN PATENT ATTORNEY
CHARTERED PATENT ATTORNEY
TRADE MARK ATTORNEY

020 8858 4039

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Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) For details of the fee and ways to pay please contact the Patent Office.

Head Slaved Area of Interest (HSAOI)
using framestore demultiplexing

The device mentioned (named Optimizer) is a device for a flight simulator display system, but could be for a wide variety of simulation display requirements such as air traffic control, driving simulation etc.

The display device can be, but is not limited to, a large array tiled projection system (60 separate high resolution displays) which achieves very high resolution throughout the field of view of the pilot etc. The reason behind the display system's large channel count is to provide very high resolution imagery everywhere in the user's field of view, approaching or exceeding eye limiting resolution. This is essential in certain training tasks, for example, spotting aircraft orientation and type at realistic distances in air traffic control simulation.

This number of channels in the display can not easily be driven with a sensibly priced graphics computer, so the device described below is configured to take a lesser quantity of images (20 in this example), and "spreads them out" over the (example) 60 channels of display. This is done by interleaving images in time, so for example, the computer outputs 60 new images per second on each of the 20 images, with different views on alternative frames. Optimizer is then instructed to freeze / unfreeze the appropriate channel, which provides 2 discrete images, at 30Hz each from a single 60Hz source. This can be extended to 4 x 15 Hz images, or 8 x 7.5 Hz images etc frm a single channel.

The invention incorporates head tracking so that the full update rate is directly ahead of the user's gaze, surrounded by a 30Hz zone, then 15Hz outside of that and so on. Since the low update rate is in the periphery, it is not distracting.

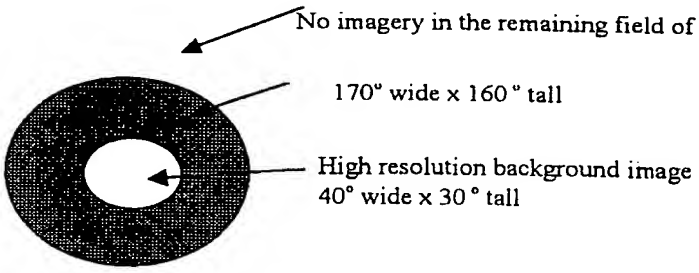
The main non-limiting claims are;

- Creating a Head Slaved Area of Interest using framestore demultiplexing.
- Using the above claim in a flight or other type of simulator
- Using the first claim in any type of large array display device
- Using a high speed video switcher with an FSD to create an Area of Interest

Background

A Head slaved Area Of Interest (HSAOI) display system is not a new concept. Various display systems have been supplied where there is a head tracker which controls where a projected image ends up on a spherical screen. The benefit of slaving a single (or two as below) image around inside a dome is that it only requires 1 or 2 Image Generator (IG) channels to cover the user's field of view.

Typical HSAOI



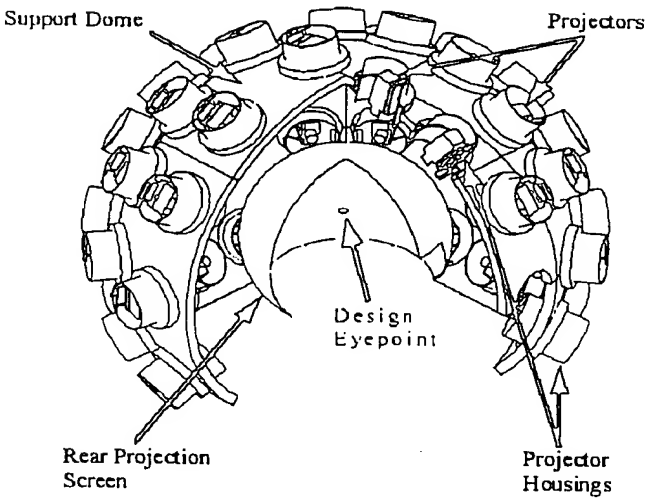
In this scenario, the high resolution & low resolution images are optically coupled such that when the steering mechanism moves these images around according to the head tracker, both move perfectly together.

This system has some drawbacks;

- The steering mechanism has to respond very quickly to head movement (low latency)
- The steering mechanism must have high acceleration & velocity to match the head's movement rates.
- The High res. field of view is quite small and the eyes can see all around into the low res background image since it is not eye tracked.
- There is no imagery outside the typical 170 x 160 low res. background image, but the human FOV is larger around 200 wide, so there is an impression of flying down a dark tunnel.
- The amount of light able to be sent through the optics is limited.

What SEOS are proposing is a variation of the SEOS Optimizer (already has a patent applied for) with a novel way of reducing the Image Generator channel count, & hence cost.

Seos Displays "Griffin" is a 60 (or other) channel multiple LCD tiled back projection sphere.



In this system, the large number of channels guarantees that high resolution is available wherever the user looks. The resolution will ultimately be eye limiting so that the display system is as resolute as the human eye.

The main problem with a 60 channel display system is what sort of computer will drive 60 channels of imagery. Using today's cost, a 30 pipe Silicon Graphics Onyx (which can produce 60 images of 1280 x 1024) will cost >£15M, so is not feasible.

Another solution would be to use low cost PC based image generators, one per channel. This will be feasible in the future, but today's PC IGs do not approach the performance of the larger Onyx type IGs.

In order to make Griffin realisable with High End Image Generators (IG) (SGI Onyx etc), we need a way of putting a useful amount of high resolution imagery where needed, and lower quality information elsewhere in the user's FOV.

By Head tracking, we know that the images outside of the human FOV are not required since you can't see them. We also know that the human visual response biases the eye's highest resolution in a small area in the middle of the FOV. If we had a perfect eye tracking system, we could envisage a display which covered only this small area (say <10 degrees) with hires imagery, but this is difficult to do. Using Head tracking, we need to cover a much larger area with hires imagery so that the eyes can roam around & still see high res.

The proposal for Griffin is to use a certain amount of channels from the Onyx or equivalent to provide a high res, full update rate (60Hz) area which is head tracked. Outside of this high res, high update rate area will be a medium update rate area (30Hz), and outside of this will be low update rate imagery (15Hz). By using a framestore on each display channel (the SEOS Mercator, which is already present to perform distortion correction), we can ask the IG to interleave different channel imagery on the same video output. This video output is sent to multiple display channels, which are asked to freeze/unfreeze to let the relevant image through to the display.

The following description is by way of example, and is not limiting.

Take 10 pipes of Onyx, each of which can generate 2 x 1280x 1024 images at 60Hz. A head tracker feeds steering information to a real-time application running on the Onyx, which contains a SEOS software application which knows where the display channels are relative to the eye. This application then controls the video switch, which can switch any input channel to any output channel in real-time.

We want 6 channels (darkest zone in the diagram below) running at 60Hz covering the area straight ahead of the user's gaze, so the software application will configure the video switcher accordingly.

The next zone (surrounding the darkest zone) comprises 14 channels which we can allow to work at 30Hz. To do this, we ask the application to interleave 2 channel's display angles. In this way, we get :

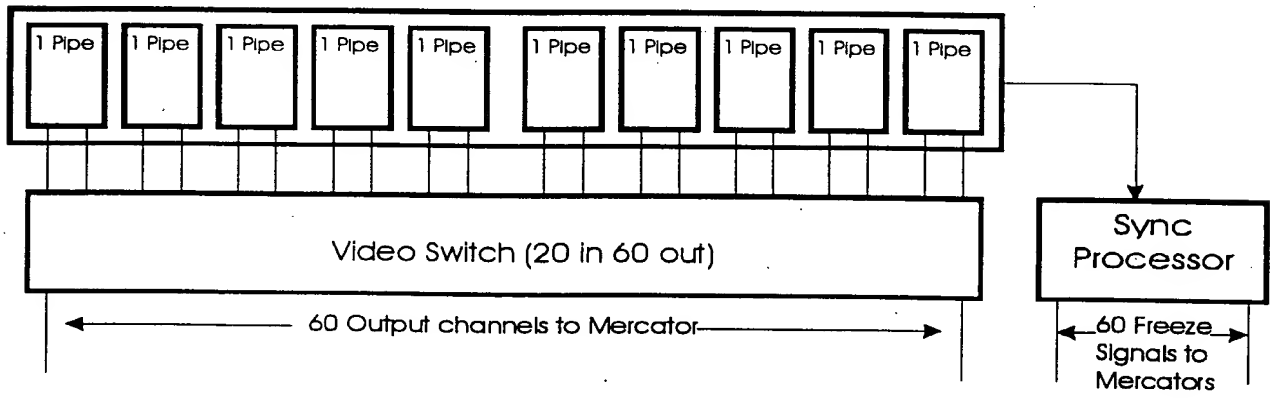
Frame 1	Frame 2	Frame 3	Frame4	Frame 5 etc	- time
View Angles For Channel 1	View Angles For Channel 2	View Angles For Channel 1	View Angles For Channel 2		

Now we use the Video switcher to feed this image to both channel 1 & 2, and send a synchronisation signal (the Sync Processor below). This implements a freeze Channel 2's Mercator (the framestore) on frame 1, and unfreeze channel 2s, then on frame 2, freeze channel 1's Mercator and unfreeze channel 2 and so on. In this way, a single video output, running at 60Hz, is being split out into two 30Hz images. The resolution is maintained at 1280 x 1024, simply the frame rate is dropped.

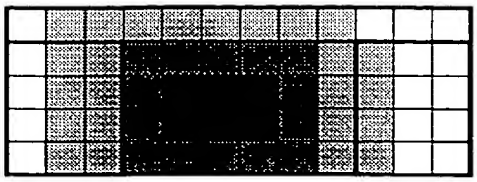
A 15Hz set of channels (4 output channels for 1 input channel) would be :

Frame 1	Frame 2	Frame 3	Frame4	Frame 5 etc	- time
View Angles For Channel 1	View Angles For Channel 2	View Angles For Channel 3	View Angles For Channel 4	View Angles For Channel 1	

A 20 channel High End IG has 20 images, which are then sent to the video switcher, which then goes to the 60 SEOS Mercator channels present on the input to the 60 projectors.



This diagram below shows the 60 channels (one small square each) of Griffin. The darkest area is at 60Hz, the next darkest at 30Hz, the light grey at 15Hz and the white squares have no image. The user's gaze is tracked so that the centre of the 60Hz area is always in front.



= 90 x 40 @ 60Hz
= 150 x 80 @ 30Hz
= 270 x 100 @ 15Hz

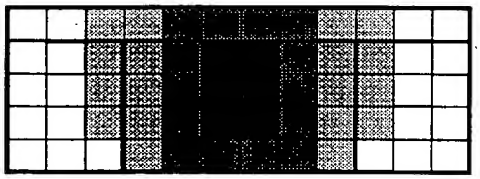
What this accomplishes is using less IG channels. Normally we need 60 to drive 60 display channels, but in the case above, we only need 20, which is much more affordable. The novel aspects of this are:

- Using a framestore to implement zoned areas which have lower update rate.
- Tracking the above area with a head tracker
- Using a high speed video switcher to implement the movement of channels
- Grouping the 15 Hz channels together such that adjacent 15Hz channels are synchronised to minimise visual artefacts caused latency.

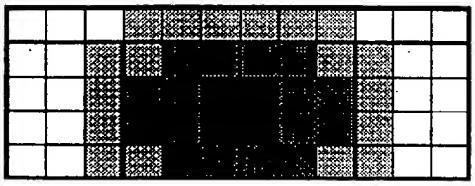
The system (assuming a 60 channel Griffin, it could be other configurations or channels counts) consists of:

- An Image Generator with n channels
- A High Speed Video Switcher with n input channels, 60 output channels
- A Sync Processor
- 60 SEOS Mercator distortion correction boxes attached to 60 projectors (not necessarily LCD)
- A head tracker
- A real-time software application which takes the head tracker input , and decides which channels are covered by zone A, B & C, then configures the switcher & Sync Processor accordingly.

Other zone sizes can be implemented, examples are given below;



= 60 x 60 @ 60Hz
= 120 x 100 @ 30Hz
= 210 x 100 @ 15Hz



= 60 x 40 @ 60Hz
= 180 x 80 @ 30Hz
= 240 x 100 @ 15Hz

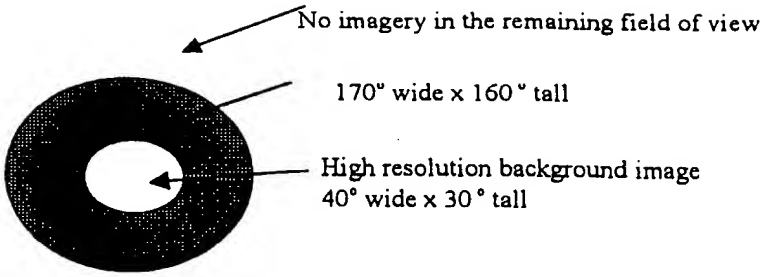
This system addresses a lot of the existing HSAOI systems;

- The High Update area is much larger
- The resolution in the surrounding zones is still very high, only the frame rate has dropped.
- There are no expensive moving parts to move the imagery around
- The brightness is very high since there are many projectors.
- The entire human FOV is covered by imagery.

Glossary

SEOS Optimizer	High speed, real-time image processing electronics that merges high resolution and low resolution imagery.
SEOS Mercator	Real-time image distortion electronics which SEOS has already developed. This will form part of Optimizer.
SEOS LUCID Griffin	Rear-projected ultra-high resolution display system comprising 60 projected images onto a small sphere.
SEOS OptiBlend	Technology to optically blend two or more images together into one larger and seamless image.
Design Eyepoint	Griffin has only one place to view the image that is correct. This is in the centre of the spherical screen and is known as the design eyepoint.
Field of View	The viewable area defined as angles measured from the user's eyes. For example, current displays may have 180° horizontally by 70° vertically. Griffin is aimed to be 360° horizontally by 145° vertically which totally surrounds the user.
Image Generator (or IG)	A graphics super-computer which can generate multiple images of a virtual world in real time so that the user can interact with the 3D world by for example, flying an aircraft around in that world.
FOV	Field of View
HSAOI	Head Slaved Area Of Interest : A head tracked high fidelity region in a larger display system.

Typical HSAOI



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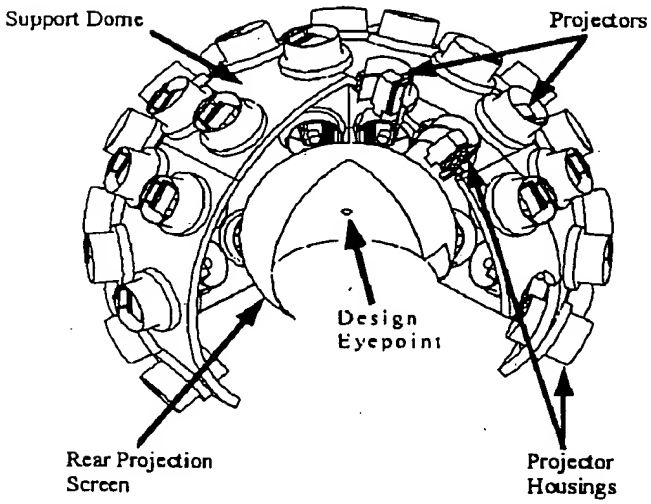

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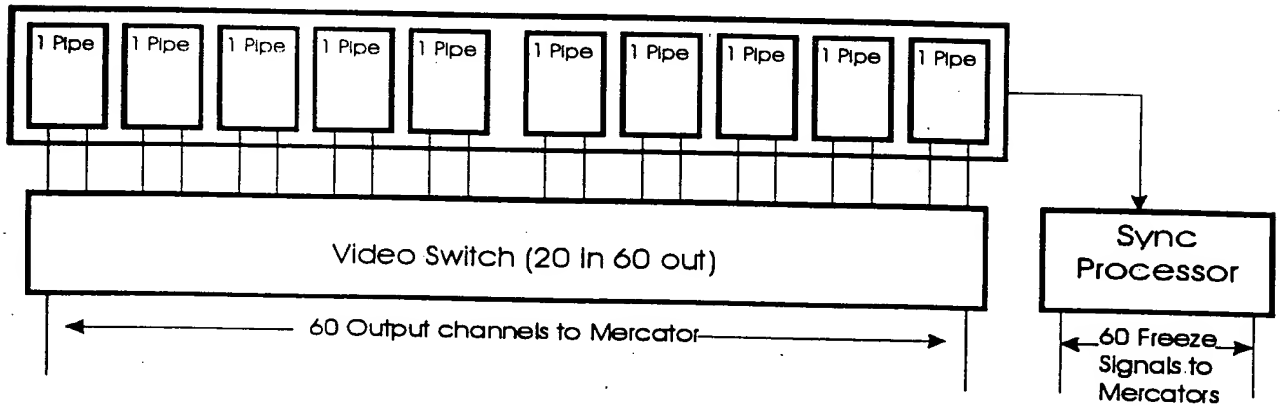

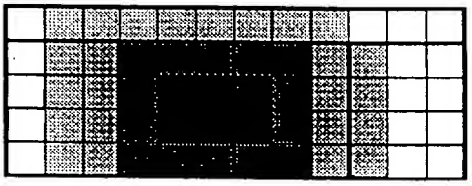

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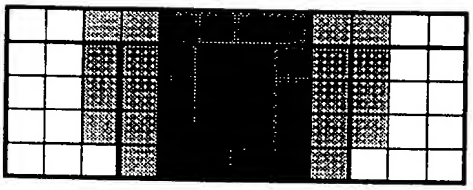

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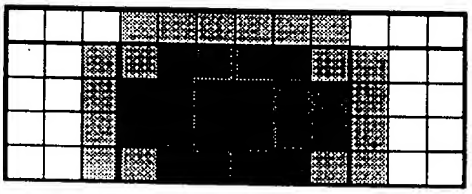

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